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CAN CHLOROPHYLL METERS PREDICT WHEAT YIELDS?

Farmers need a reliable, easy-to-use method for determining the nitrogen (N) status of wheat that can be used to better manage N fertilizer applications. Applying too little N reduces wheat yields, while applying too much is not economical and poses a threat to water quality. Nitrogen fertilizer applications to wheat can be particularly inefficient because wheat is grown during the winter when rainfall is high and loss of water by evaporation and plant use (evapotranspiration) is low. If researchers can determine the wheat N status at critical growth stages, the information could be used to help predict how much N should be applied to a wheat crop.

Recently, hand-held meters that measure leaf greenness as an indicator of chlorophyll concentration in the plant have become available in the United States. Because chlorophyll is largely made up of nitrogen, readings from these meters may be useful for determining the N status of crops, such as wheat. Unlike other methods of determining N status of crops that require sending plant samples to a laboratory for analysis, chlorophyll meter measurements are easily made in the field.

A field study at the E. V. Smith Research Center, Shorter, recently evaluated the ability of these meters to determine the N status of wheat grown with different management conditions. The study was a cooperative effort by the AAES and the USDA Agricultural Research Service and was supported in part by the Alabama Farmers Federation's Wheat and Feed Grain Check-Off Program.

Saluda wheat was sown following disk harrowing with and without deep tillage using a paraplow. Nitrogen rates of 0, 40, 80, 120, and 160 pounds per acre were applied to the wheat with 20 pounds per acre applied at planting and the remainder applied in mid-February. Half the plots received an application of Tilt® fungicide when the flag leaf was just visible (Feekes Growth Stage 8). Whole plant samples were collected at the late tillering stage (Feekes Growth Stage 3) and just prior to jointing (Feekes Growth Stage 5) for determination of dry weight and N concentration. At flowering (Feekes Growth Stage 10.5), flag leaf samples were taken for N analysis. In 1991, at these three sampling times, leaf greenness also was measured with a Minolta SPAD-502® chlorophyll meter.

EFFECT OF MANAGEMENT PRACTICES ON WHEAT GRAIN YIELD AT E.V. SMITH RESEARCH CENTER IN 1990 AND 1991

	Nitrogen, lb./a.				
	0	40	80	120	160
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*
1990					
Paraplow					
Tilt®	11	22	40	43	44
No fungicide	10	20	37	40	35
Disk					
Tilt®	10	21	38	47	45
No fungicide	8	19	36	37	41
1991					
Paraplow					
Tilt®	7	18	23	27	24
No fungicide	6	14	17	16	16
Disk					
Tilt®	7	12	18	22	22
No fungicide	2	10	12	13	13

In 1990, there was little response to paraplowing, but application of Tilt increased yields and maximum yields were obtained with 120 pounds N per acre (see table). At the 160 pounds per acre N rate, paraplowing without Tilt application actually reduced yield. Wheat yields throughout the state were low in 1991 due to scab head blight. In 1991 the highest yields were obtained with 120 pounds N per acre in conjunction with paraplowing and Tilt application.

Nitrogen concentrations in wheat plants were highly correlated to chlorophyll meter readings at all three growth stages. Management factors, paraplowing, and application of Tilt not only affected yields but also affected the relationship between plant N content and meter readings. Chlorophyll meter readings also can be affected by factors such as cold stress and choice of wheat variety.

Chlorophyll meter readings taken at Feekes Growth Stage 3 were not good predictors of yield. This growth stage proved too early to accurately predict wheat N needs. Of all the measurements taken, the best predictor of yield was plant N uptake just prior to jointing. Eighty-five percent of the variation in yield among treatments could be explained by plant N uptake at this time. Plant N uptake requires measurements of wheat dry weight in a determined area, for example one-square yard, and laboratory analysis to determine the N concentration in the plant sample. A combination of dry matter measurements and chlorophyll meter readings taken just prior to jointing was nearly equal to plant N uptake measurements in predicting wheat yield. Eighty-one percent of the variation in yield was explained by these two measurements used together.

The ability for dry matter weights and chlorophyll meter readings taken just prior to jointing to account for such a high amount of the variation in yield in this experiment suggests that these two measurements hold promise as a means to predict the amount of N fertilizer needed by wheat at this growth stage. Since this is the growth stage of wheat when the bulk of N fertilizer is applied, and since both of these measurements can be conducted easily on the farm without sending samples to the laboratory, this technology is very practical. Additional research is being conducted to test this technology in combination with soil nitrate tests to develop improved quick and reliable methods for predicting N fertilizer requirements for winter wheat.

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